PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 16756-3PCT	**FOR FURTHER ACTION**	See Form PCT/IPEA/416
International application No. PCT/CA2004/002106	International filing date *(day/month/year)* 10 December 2004 (10-12-2004)	Priority date *(day/month/year)* 12 December 2003 (12-12-2003)

International Patent Classification (IPC) or national classification and IPC
IPC: ***G01R 27/02*** (2006.01), ***C25B 11/00*** (2006.01), ***G01R 29/08*** (2006.01), ***G01R 31/00*** (2006.01), ***G01R 29/00*** (2006.01), ***G01R 33/00*** (2006.01)

Applicant
B.D.H. INDUSTRIES INC. ET AL

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 3 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. [X] *(sent to the applicant and to the International Bureau)* a total of 9 sheets, as follows:
      [X] sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      [ ] sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. 1 and the Supplemental Box.
   b. [ ] *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s))
      , containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).
4. This report contains indications relating to the following items:
   - [X] Box No. I Basis of the report
   - [ ] Box No. II Priority
   - [ ] Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - [ ] Box No. IV Lack of unity of invention
   - [X] Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - [ ] Box No. VI Certain documents cited
   - [ ] Box No. VII Certain defects in the international application
   - [ ] Box No. VIII Certain observations on the international application

Date of submission of the demand 26 May 2005 (26-05-2005)	Date of completion of this report 25 January 2006 (25-01-2006)
Name and mailing address of the IPEA/CA Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 001(819)953-2476	Authorized officer Eric Lafontaine (819) 956-9965

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/CA2004/002106

Box No. I Basis of the report

1. With regard to the **language,** this report is based on:

[X] the international application in the language in which it was filed

[ ] a translation of the international application into , which is the language of a translation furnished for the purposes of:

[ ] international search (Rules 12.3(a) and 23.1(b))

[ ] publication of the international application (Rule 12.4(a))

[ ] international preliminary examination (Rules 55.2(a) and/or 55.3(a))

2. With regard to the **elements** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

[ ] the international application as originally filed/furnished

[X] the description:

[X]	pages	1, 5-8		as originally filed/furnished
[X]	pages*	2-4, 4a	received by this Authority on	26-05-2005
[ ]	pages*		received by this Authority on	

[X] the claims:

[ ]	pages			as originally filed/furnished
[ ]	pages*		as amended (together with any statement) under Article 19	
[X]	pages*	9-12	received by this Authority on	26-05-2005
[X]	pages*	13	received by this Authority on	30-11-2005

[X] the drawings:

[X]	pages			as originally filed/furnished
[ ]	pages*		received by this Authority on	
[ ]	pages*		received by this Authority on	

[ ] a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing.

3. [X] The amendments have resulted in the cancellation of:

[X] the description, pages 2-4

[X] the claims, Nos. 1-17

[ ] the drawings, sheets/figs

[ ] the sequence listing *(specify):*

[ ] any table(s) related to sequence listing *(specify):*

4. [ ] This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

[ ] the description, pages

[ ] the claims, Nos.

[ ] the drawings, sheets/figs

[ ] the sequence listing *(specify):*

[ ] any table(s) related to sequence listing *(specify):*

* *If item 4 applies, some or all of those sheets may be marked "superseded."*

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/CA2004/002106

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-17	YES
	Claims	none	NO
Inventive step (IS)	Claims	1-17	YES
	Claims	none	NO
Industrial applicability (IA)	Claims	1-17	YES
	Claims	none	NO

2. Citations and explanations (Rule 70.7)

Reference is made to the following document:

D1 = US 5 552 704

Document D1 discloses a method and apparatus for performing conductance measurement on a sample using an eddy current probe. The probe comprises sense and drive coils mounted in close proximity to each other, circuitry for producing AC voltage in the drive coil, and a meter for measuring in-phase and quadrature components of induced voltage in the sense coil.

I. Novelty:

1. The combination of features disclosed in claims 1 to 17 are considered to be novel as no reference disclosed all the elements and limitations of the claimed device and methods. In particular, no reference, including D1 which is considered the closest prior art, discloses that the signal from the sensing device is obtained using an anode before baking while the value obtained from the means for calculating is indicative of the electrical conductivity of the anode after baking thereof. The subject matter of claims 1 to 17 therefore complies with PCT Article 33(2).

II. Inventive Step:

2. From the above observations, the combination of features disclosed in claims 1 to 17 are considered to involve an inventive step as no reference alone or in combination disclosed the elements and limitations of the claimed device and methods. The subject matter of claims 1 to 17 therefore complies with PCT Article 33(3).

III. Industrial applicability:

The claimed subject matter of claims 1 to 17 is considered to be industrially applicable and thus fulfilling the requirements of PCT Article 33(4).

contains between 10 and 20% by weight of pitch, which generally yields a product having a good cohesion and an adequate electrical conductivity.

Optimizing the electrical conductivity of anodes is relatively important in terms of operation costs. When the current flows through the anodes, a part of the energy is transformed into heat. This energy is wasted and must be minimized to improve the efficiency of the process and the aluminum production rate. Therefore, anodes must ideally have the highest possible electrical conductivity.

The percentage of pitch is generally adjusted according to the size distribution of coke particles. Higher content of pitch is necessary to bind particle of smaller diameter. When the target composition of the mixture is obtained, a pre-defined amount is pressed and possibly vibrated into a mold having the form of the anode. The resulting product coming out of the mold is a crude anode block weighing between 500 to 1500 kg. Then, the crude anode must be baked, typically for 10 to 15 days, to decompose the pitch into carbon so as to create a permanent binding between coke particles. The baking of anodes is usually done in pits in which a large number of anodes is set. It is only after the baking that the electrical conductivity of the anodes can be measured using conventional measuring devices. Before baking, any measurements using these conventional devices are generally unreliable. The electrical conductivity of baked anodes can also be measured when they are in operation in a cell.

As can be seen, any unintentional variation occurring during the manufacturing process of the anodes may go undetected until the baking of these anodes is completed, thus many days after their manufacturing process started. Many factors can affect the electrical conductivity of anodes, all of which represent challenges for the manufacturers of anodes. One of these challenges is the variation of the coke particle size. Typically, coke particle size can vary from 100 microns to 5 cm. The size distribution can vary from one batch to another, thereby resulting in anodes of different electrical conductivity unless the pitch proportion is adjusted accordingly. Another challenge is to keep an accurate proportion of ingredients in the mixture, particularly the pitch. Pitch is a highly viscous product difficult to handle so that the exact amount supplied by the pitch distribution apparatus to the initial mixture may vary from one batch to another. There are also other challenges, such as obtaining a

very homogenous mixture of the ingredients, preventing air from being entrapped in the mixture and create voids, obtaining an optimal compaction of the mixture in the molds before baking, and preventing elastic deformation of the coke particles in effort to avoid layer separation in the blocks. All these factors may potentially shift the electrical conductivity of one or several anodes out of the target value. As aforesaid, this will only be known once the anodes are baked, thus many days later. At that point, corrections can be made to the manufacturing process but the anodes already manufactured or currently being baked may be defective or otherwise less desirable.

One aspect of the present invention is to provide a system to forecast the electrical conductivity of an anode for aluminum production, the system comprising:

an electromagnetic field emitting unit to generate an excitation electromagnetic field;

at least one receiving coil electromagnetically coupled to the electromagnetic field emitting unit;

a sensing device connected to the receiving coil, the sensing device outputting a signal indicative of a variation of the electromagnetic field received by the receiving coil as the anode, or a sample thereof, passes inside the receiving coil;

a carriage unit to move the anode, or the sample thereof, at least relative to the receiving coil; and

means for calculating a value indicative of the electrical conductivity of the anode using at least the signal from the sensing device and signals previously obtained using reference anodes;

the system being characterized in that:

the signal from the sensing device is obtained using the anode before baking thereof;

the value obtained from the means for calculating is indicative of the electrical conductivity of the anode after baking thereof.

Another aspect of the present invention is to provide a method for forecasting the electrical conductivity of an anode for aluminum production, the method comprising:

generating an excitation electromagnetic field;

moving the anode, or a sample thereof, within at least one receiving coil electromagnetically coupled to the electromagnetic field;

sensing a variation in the electromagnetic field received by the at least one receiving coil and outputting a signal indicative thereof; and

calculating a value indicative of the electrical conductivity of the anode;

the method being characterized in that:

the anode, or the sample thereof, is moved within the at least one receiving coil before baking of the anode;

the value indicative of the electrical conductivity of the anode is calculated using the signal indicative of the variation in the electromagnetic field received by the at least one receiving coil and previously-recorded signals obtained with reference anodes before baking thereof and for which the electrical conductivity has also been measured after baking; and

the calculated value is indicative of the electrical conductivity of the anode after baking.

Another aspect of the present invention is to provide a method of forecasting the electrical conductivity of an anode for aluminum production before baking thereof, the method being characterized in that it comprises:

sensing a variation caused by a first reference crude anode to an excitation electromagnetic field received by at least one receiving coil;

sensing the variation for a plurality of other reference crude anodes having various compositions;

measuring the electrical conductivity of the reference anodes after baking thereof;

determining a correlation between the sensed variations for the reference anodes before baking and their electrical conductivity measured after baking;

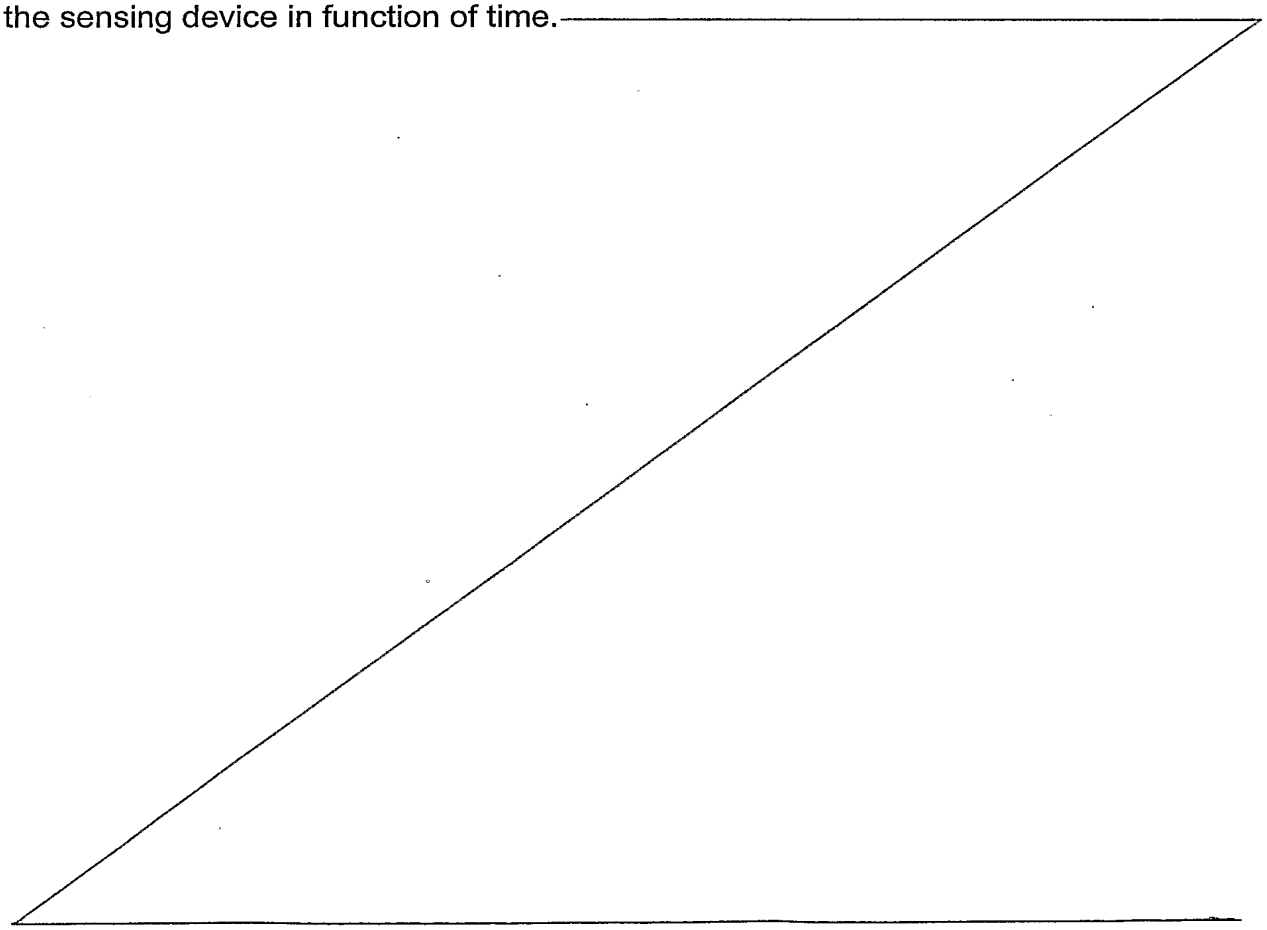
sensing the variation for an additional anode before baking thereof; and

calculating a value indicative of the electrical conductivity of the additional anode using the correlation between the sensed variations for the reference anodes before baking and their measured electrical conductivity after baking.

These and other aspects are described in or apparent from the following detailed description made in conjunction with the accompanying figures, in which:

FIG. 1 is a schematic view of an example of a system to forecast the electrical conductivity of an anode.

FIG. 2 is a graph schematically depicting an example of a possible signal sensed by the sensing device in function of time.



CLAIMS:

1. A system (10) to forecast the electrical conductivity of an anode (12) for aluminum production, the system (10) comprising:

an electromagnetic field emitting unit (14,18) to generate an excitation electromagnetic field;

at least one receiving coil (20,22) electromagnetically coupled to the electromagnetic field emitting unit (14,18);

a sensing device (30) connected to the receiving coil (20,22), the sensing device (30) outputting a signal indicative of a variation of the electromagnetic field received by the receiving coil (20,22) as the anode (12), or a sample thereof, passes inside the receiving coil (20,22);

a carriage unit (40) to move the anode (12), or the sample thereof, at least relative to the receiving coil (20,22); and

means for calculating a value indicative of the electrical conductivity of the anode (12) using at least the signal from the sensing device (30) and signals previously obtained using reference anodes;

the system (10) being characterized in that:

the signal from the sensing device (30) is obtained using the anode (12) before baking thereof;

the value obtained from the means for calculating is indicative of the electrical conductivity of the anode (12) after baking thereof.

2. The system (10) as defined in claim 1, characterized in that two opposite receiving coils (20,22) are provided with reference to the electromagnetic field emitting unit (14,18), both receiving coils (20,22) being in serial connection with each other.

3. The system (10) as defined in claim 2, characterized in that the receiving coils (20,22) have oppositely winded coils, both coils having substantially identical characteristics and being coaxially positioned with reference to a main axis (M).

4. The system (10) as defined in claim 3, characterized in that the electromagnetic field emitting unit (14,18) includes an AC generator (18) connected to an emitting coil (14).

5. The system (10) as defined in claim 4, where in the AC generator (18) operates at a frequency between 100 and 10,000 Hertz.

6. The system (10) as defined in claim 4 or 5, characterized in that the emitting coil (14) is substantially coaxial with reference to the main axis (M).

7. The system (10) as defined in claim 4, 5 or 6, characterized in that the receiving coils (20,22) are substantially equidistant with reference to the emitting coil (14).

8. The system (10) as defined in any one of claims 1 to 7, characterized in that the sensing device (30) includes an ammeter.

9. The system (10) as defined in any one of claims 1 to 8, characterized in that the means for calculating the value indicative of the electrical conductivity of the anode (12) include a computer, the computer (32) having a memory (34) in which are recorded the signals previously obtained using the reference anodes (12).

10. A method for forecasting the electrical conductivity of an anode (12) for aluminum production, the method comprising:

generating an excitation electromagnetic field;

moving the anode (12), or a sample thereof, within at least one receiving coil (20,22) electromagnetically coupled to the electromagnetic field;

sensing a variation in the electromagnetic field received by the at least one receiving coil (20,22) and outputting a signal indicative thereof; and

calculating a value indicative of the electrical conductivity of the anode (12);

the method being characterized in that:

the anode (12), or the sample thereof, is moved within the at least one receiving coil (20,22) before baking of the anode (12);

the value indicative of the electrical conductivity of the anode (12) is calculated using the signal indicative of the variation in the electromagnetic field received by the at least one receiving coil (20,22) and previously-recorded signals obtained with reference anodes before baking thereof and for which the electrical conductivity has also been measured after baking; and

the calculated value is indicative of the electrical conductivity of the anode (12) after baking.

11. The method as defined in claim 10, characterized in that it further comprises:

comparing the value indicative of the electrical conductivity of the anode (12) to a threshold value; and

discarding the anode (12) before baking based on the fact that its forecasted electrical conductivity is below the threshold value.

12. The method as defined in claim 11, characterized in that it further comprises:

modifying composition of subsequently-manufactured crude anodes (12) based on the forecasted electrical conductivity of the anode (12) so as to optimize the electrical conductivity of the subsequently-manufactured anodes (12) after baking.

13. The method as defined in any one of claims 10 to 12, characterized in that the value indicative of the electrical conductivity of the anode (12) is calculated using a value indicative of a maximum variation in the signal.

14. A method of forecasting the electrical conductivity of an anode (12) for aluminum production before baking thereof, the method being characterized in that it comprises:

sensing a variation caused by a first reference crude anode to an excitation electromagnetic field received by at least one receiving coil (20,22);

sensing the variation for a plurality of other reference crude anodes having various compositions;

measuring the electrical conductivity of the reference anodes after baking thereof;

determining a correlation between the sensed variations for the reference anodes before baking and their electrical conductivity measured after baking;

sensing the variation for an additional anode (12) before baking thereof; and

calculating a value indicative of the electrical conductivity of the additional anode (12) using the correlation between the sensed variations for the reference anodes before baking and their measured electrical conductivity after baking.

15. The method as defined in claim 14, characterized in that it further comprises:

comparing the forecasted electrical conductivity of the additional anode (12) to a threshold value; and

discarding the additional anode (12) before baking based on the fact that its forecasted electrical conductivity is below the threshold value.

16. The method as defined in claim 14 or 15, characterized in that it further comprises:

modifying the composition of subsequently-manufactured additional crude anodes (12) based on the forecasted electrical conductivity of the additional anode (12) in effort to meet the electrical conductivity threshold.

17. The method as defined in any one of claims 14 to 16, characterized in that the value indicative of the electrical conductivity of the additional anode (12) is calculated using a value indicative of a maximum variation in the signal.